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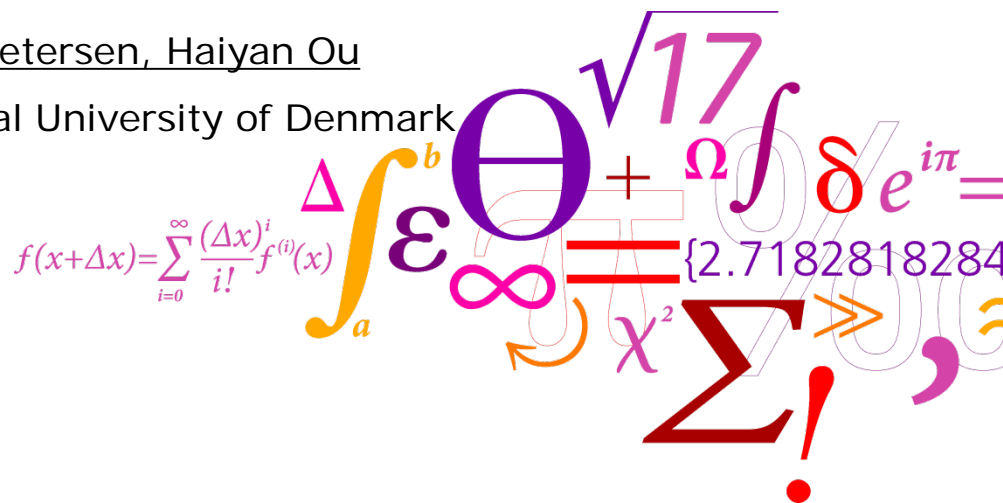
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Scalable nanostructuring on polymer by a SiC stamp: optical and wetting effects

Aikaterini Argyraki, Weifang Lu, Paul Michael Petersen, Haiyan Ou

Department of Photonics Engineering, Technical University of Denmark



Outline

Motivation

Fabrication

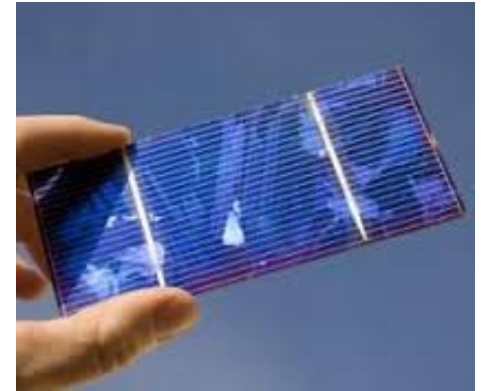
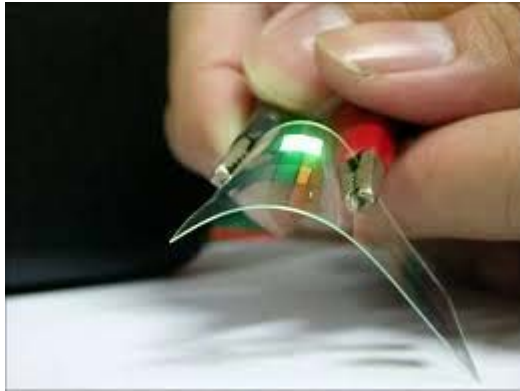
- Wafer-Scale nanostructuring of SiC stamp
- Replication of nanostructures on a polymer surface

Characterization

- Optical effects
- Wetting properties

Conclusions

Motivation



Push performance of devices towards their optimum limits by controllable fabrication of interfaces at the nanoscopic level.

Polymer materials gain interest both as semiconductors and conductors due to their low cost.

Prerequisites

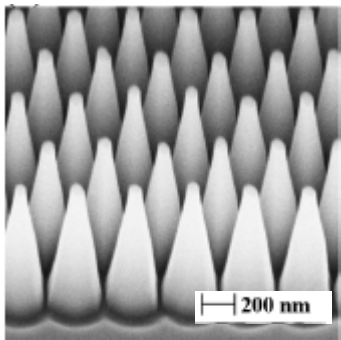
Fabrication of nanostructures that result in macroscale effects with reproducibility !

and....nanopattern definition must be:

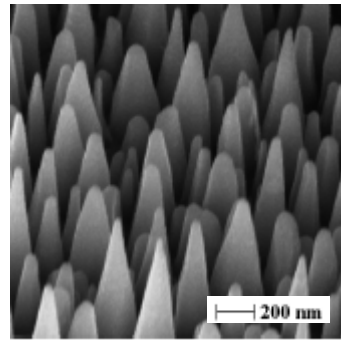
- Rapid
- Low-cost
- Applicable on wafer scale-high throughput

SiC nanostructuring: summary table

Type of structures	Method	Average Reflectance (%)	Luminescence enhancement (from 10 to 80 degrees)
Periodic	E-beam	1,01	104%
Semi-periodic	Self-assembly	1,62	67%



Periodic



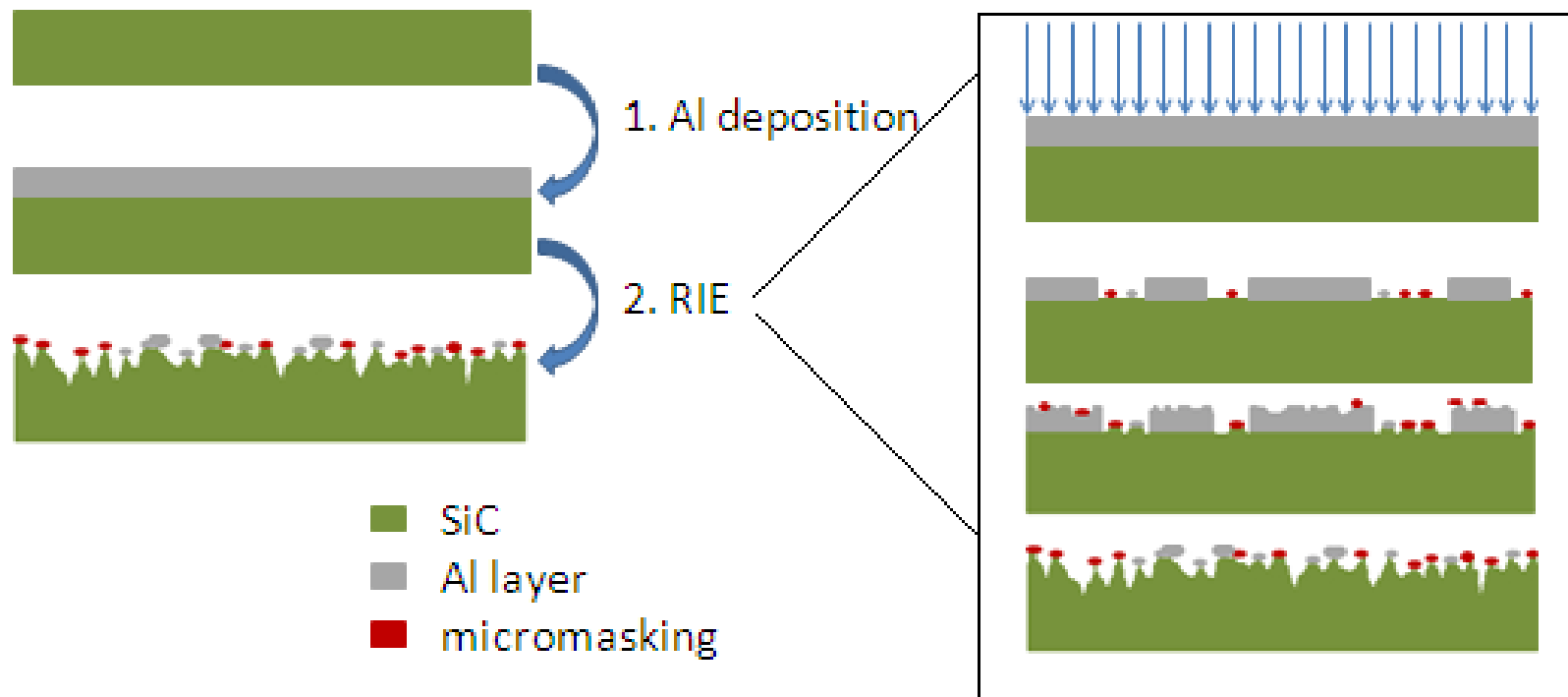
Semi-periodic

*Reference:

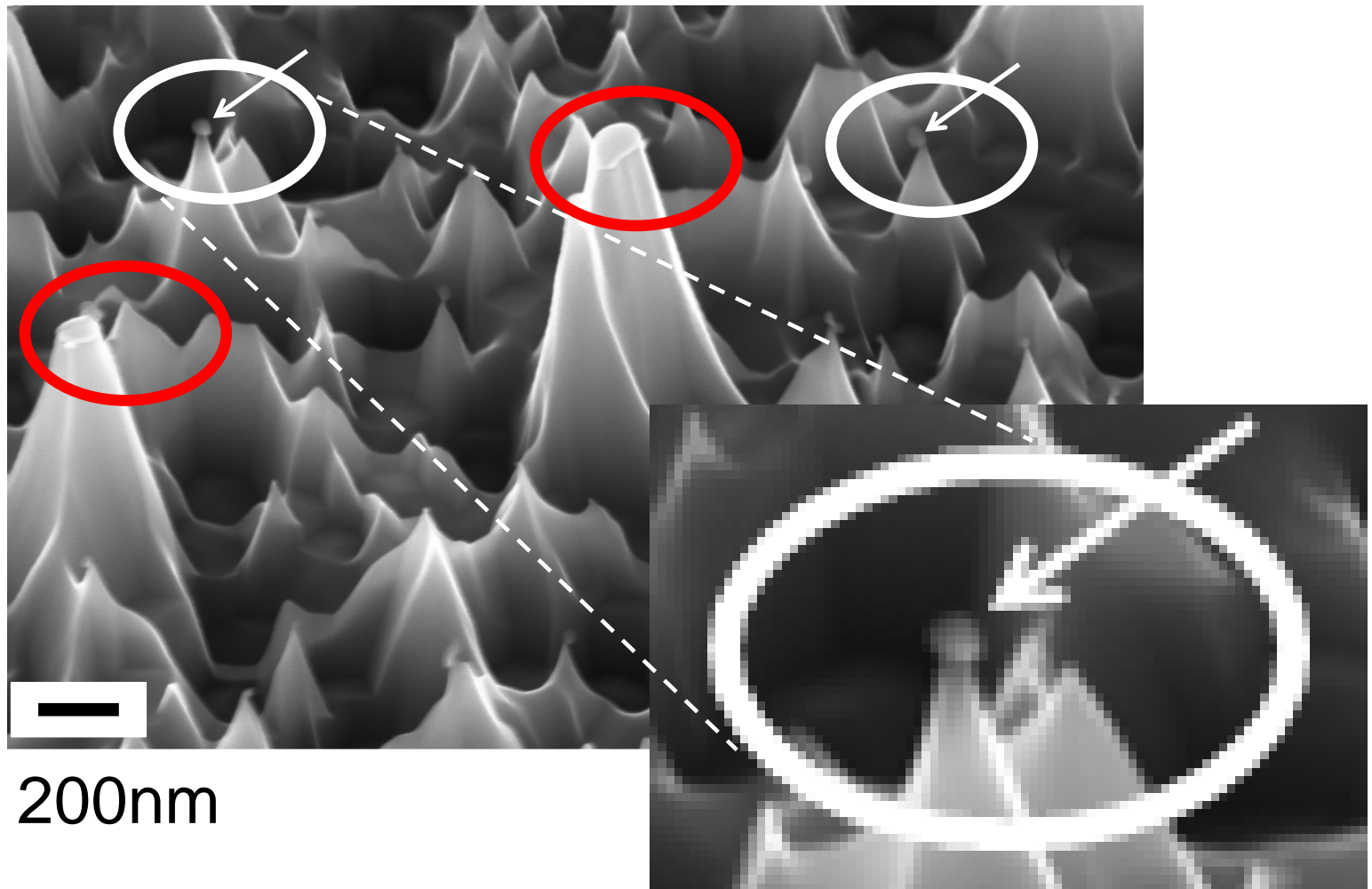
Y. Ou, et al., Optics Express 20, 7, 2012.

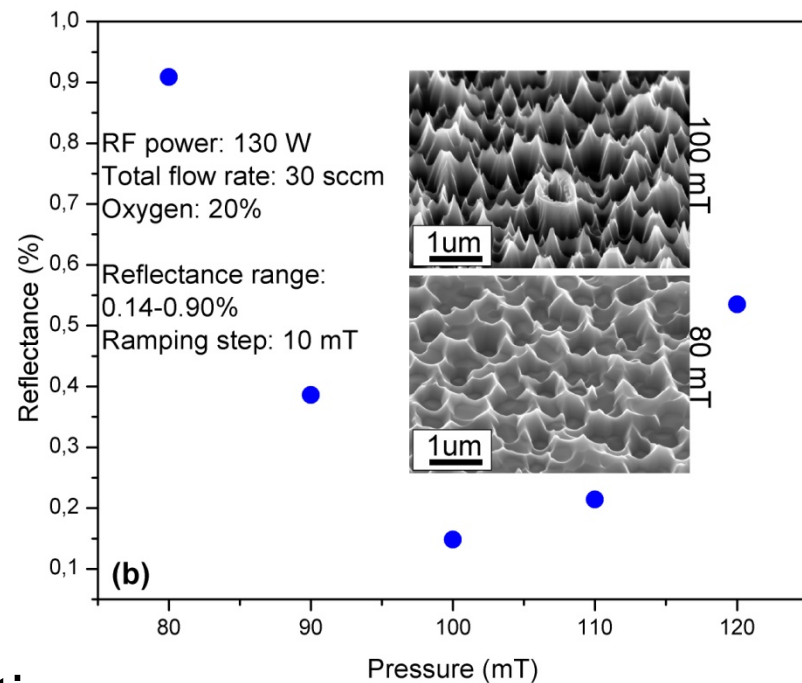
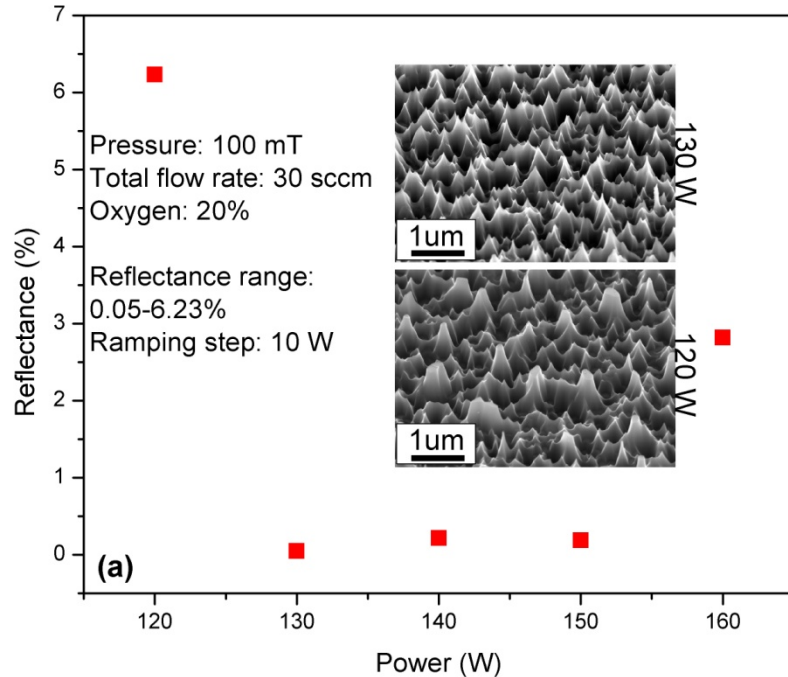
Y. Ou, et al., Opt. Lett. 37, 18, 2012.

A cost effective method for SiC aperiodic nanostructuring



Combinatorial masking

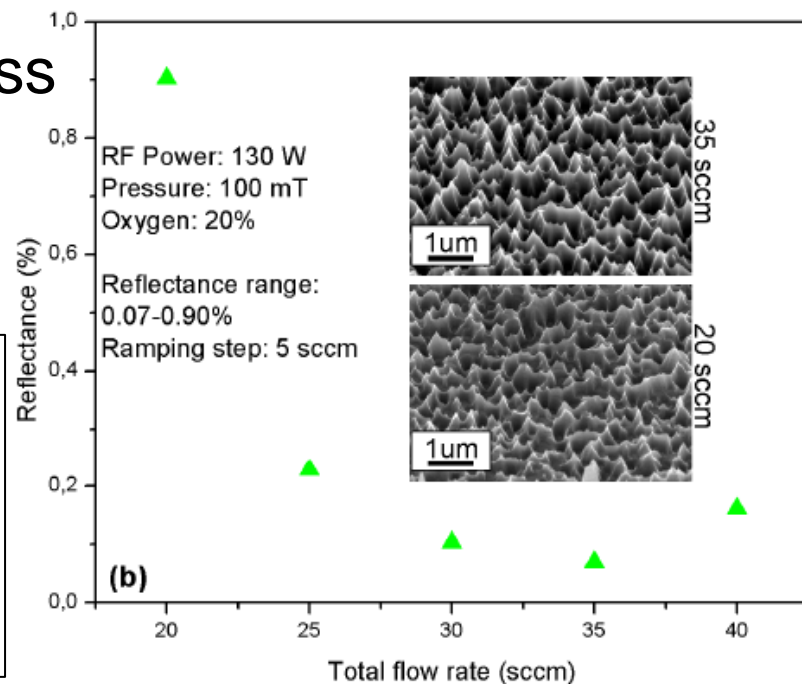
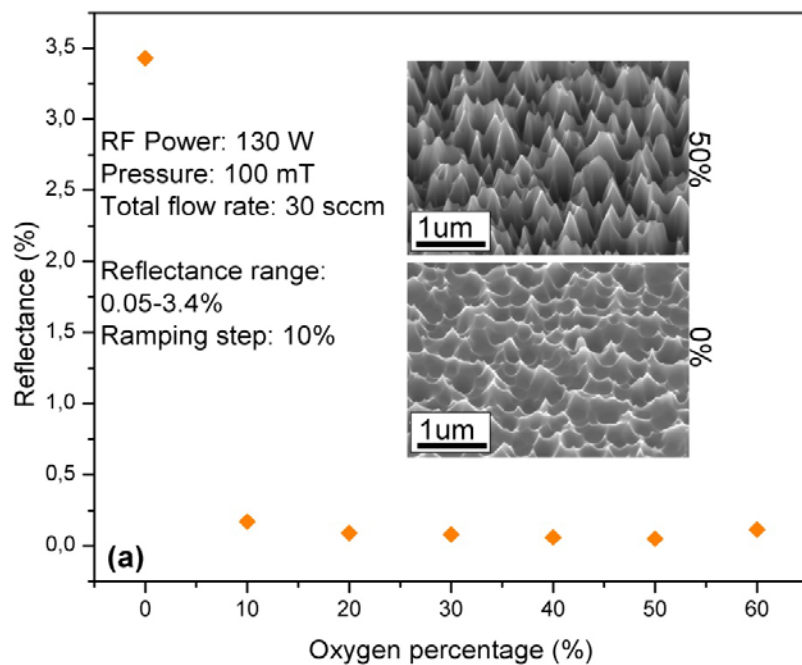




Ramping:

RIE conditions+

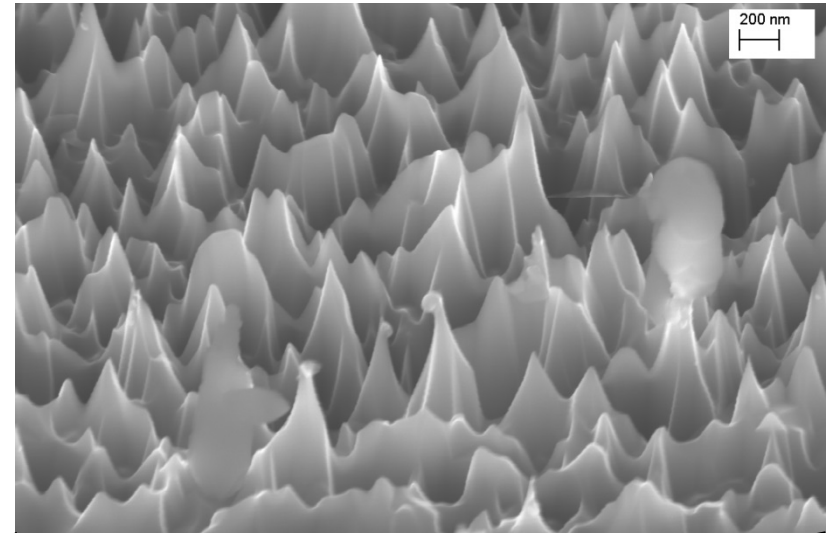
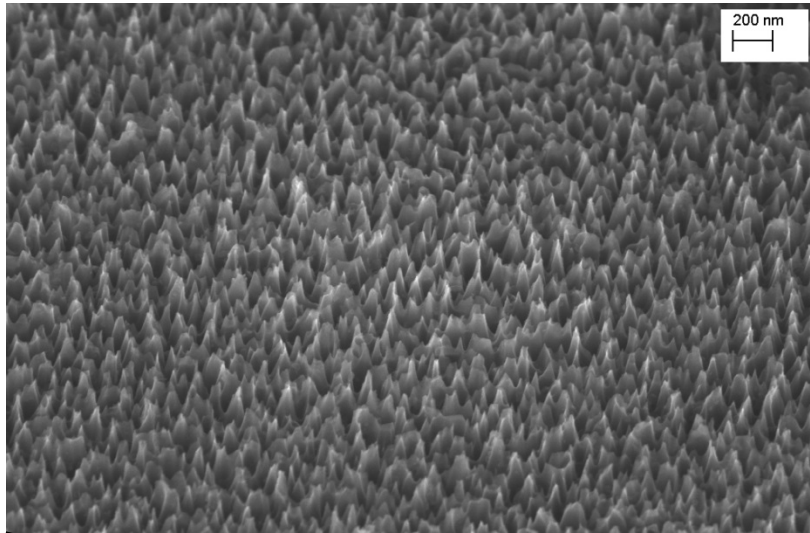
Al thickness



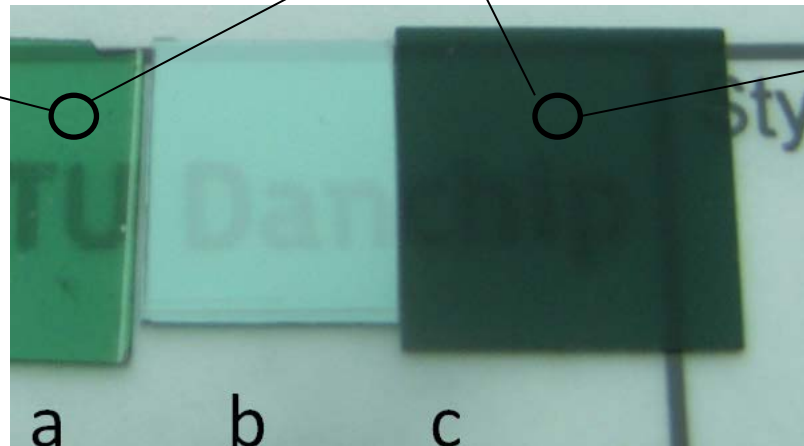
*Reference:

A. Argyraki et
al., Optical
Materials
Express 8(3)
2013.

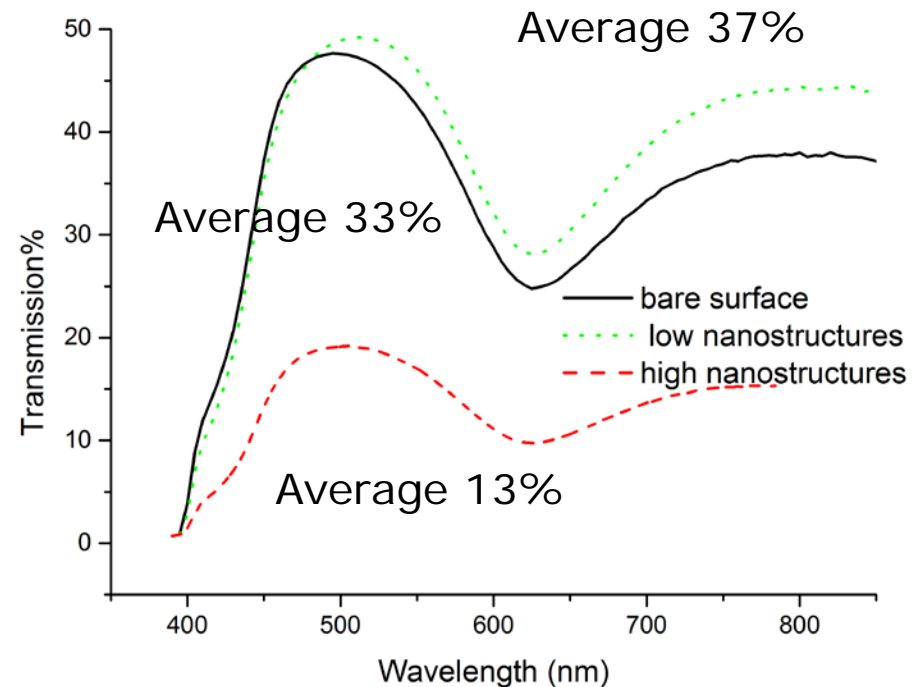
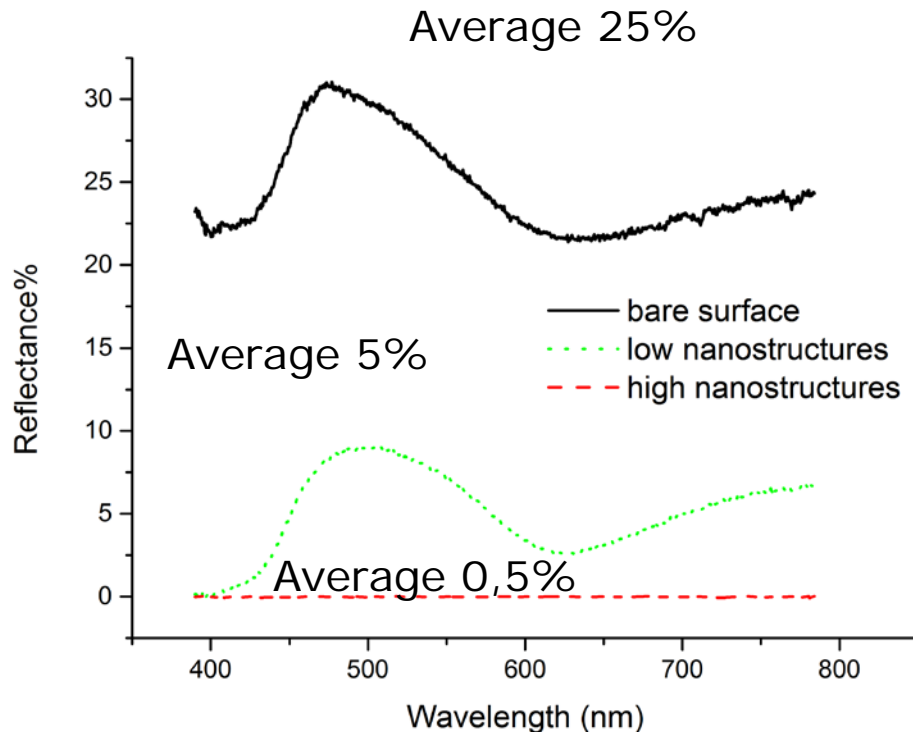
Fabrication of different nanotopographies



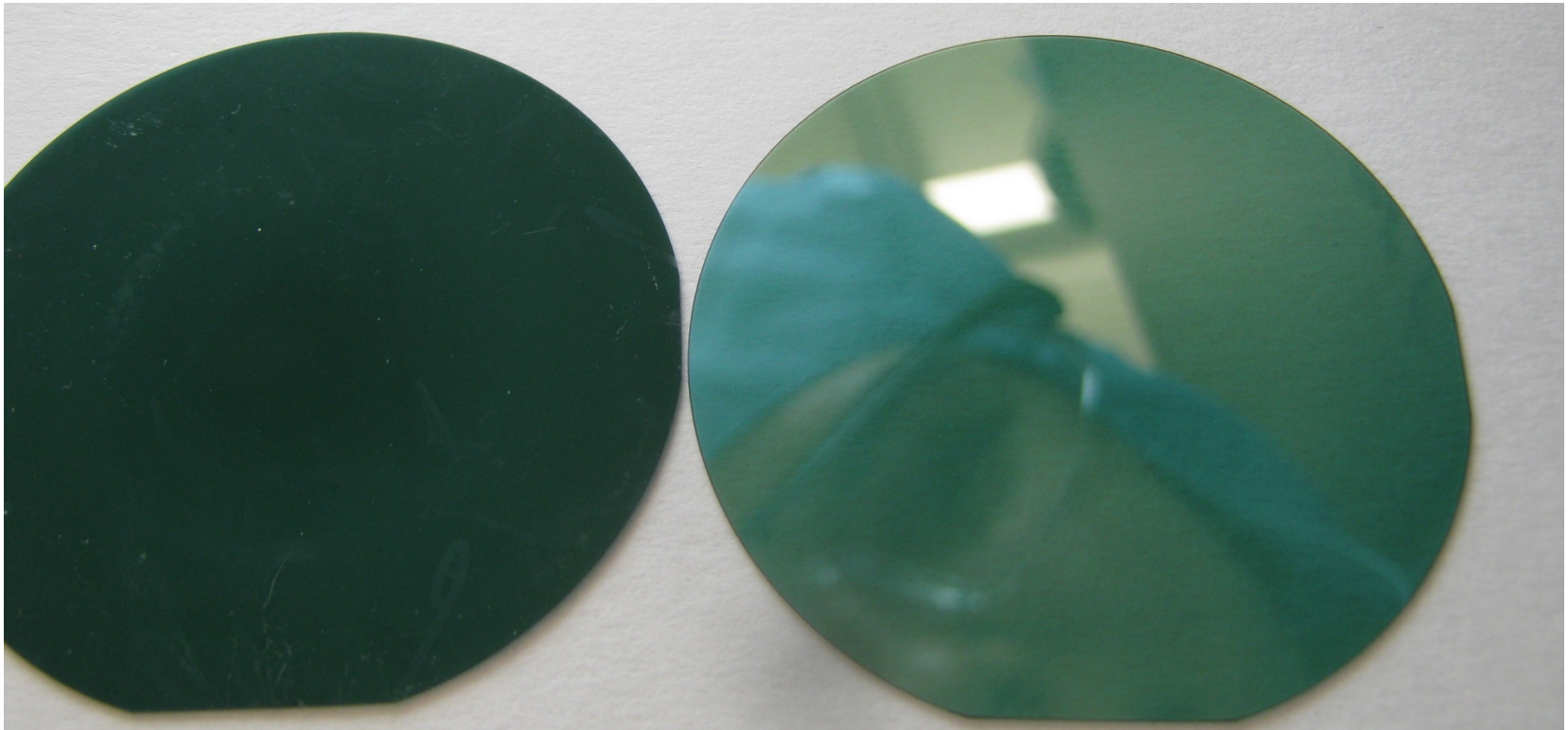
Color texture
changes due to
nanostructuring



Optical properties: Reflection, Transmission

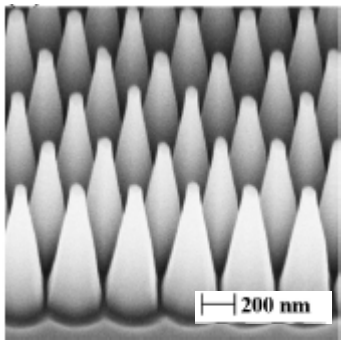


Scalability

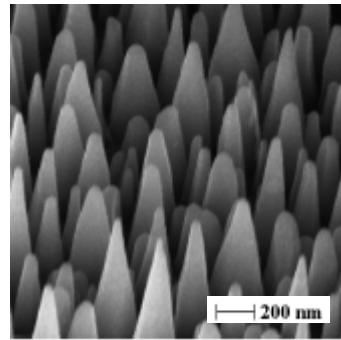


Summary table

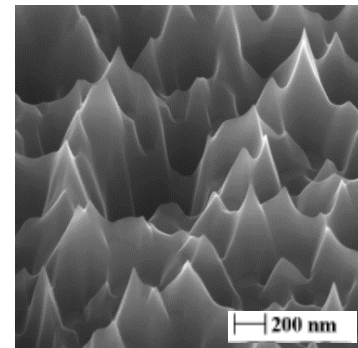
Type of structures	Method	Average Reflectance (%)	Luminescence enhancement (from 10 to 80 degrees)
Periodic	E-beam	1,01	104%
Semi-periodic	Self-assembly*	1,62	67%
Stochastic	Combinatory masking	0,50	165%



Periodic



Semi-periodic

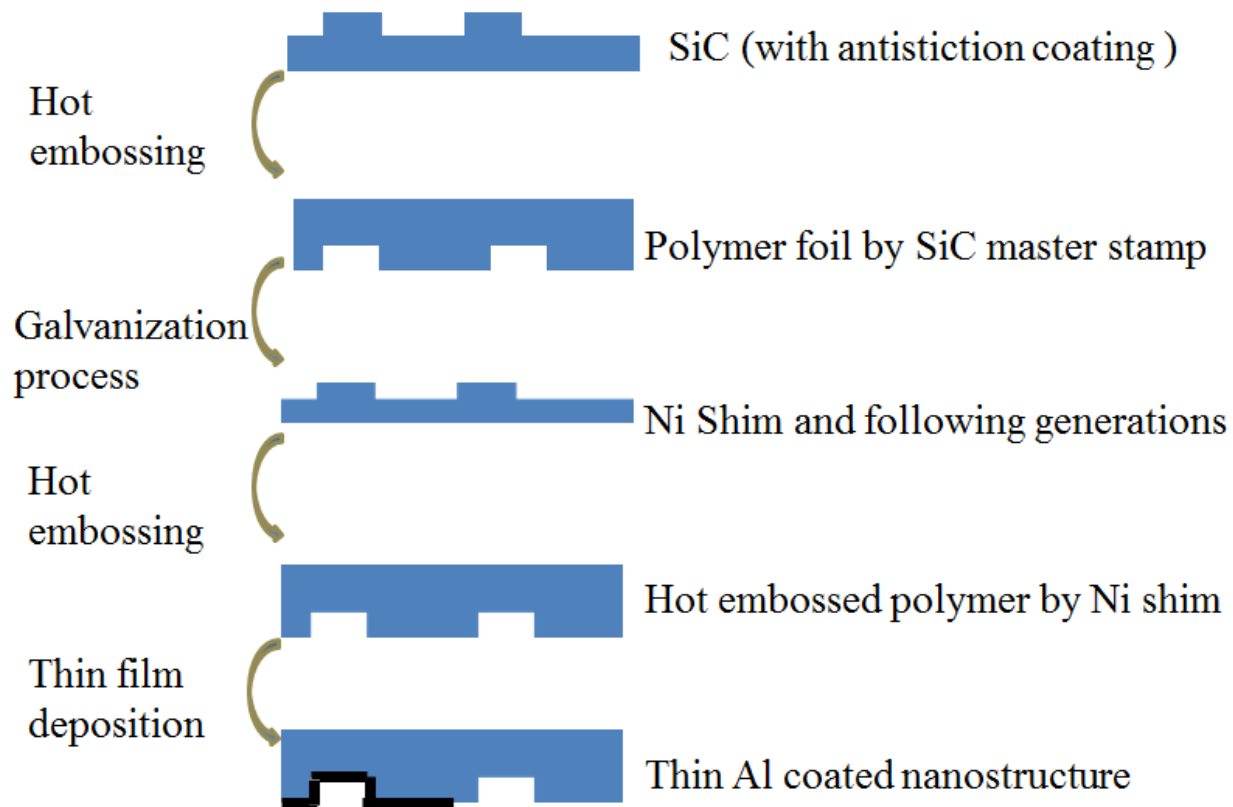


Stochastic

*Reference:

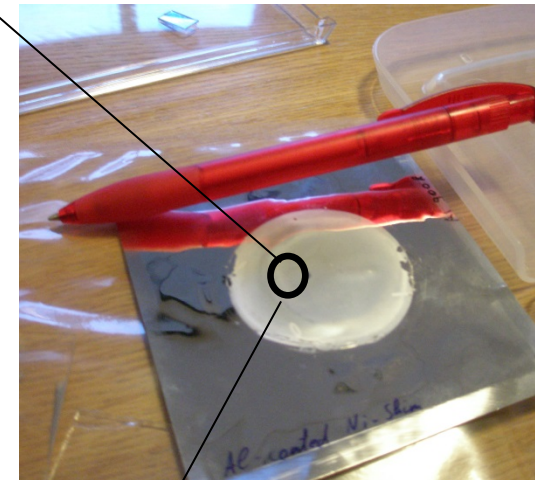
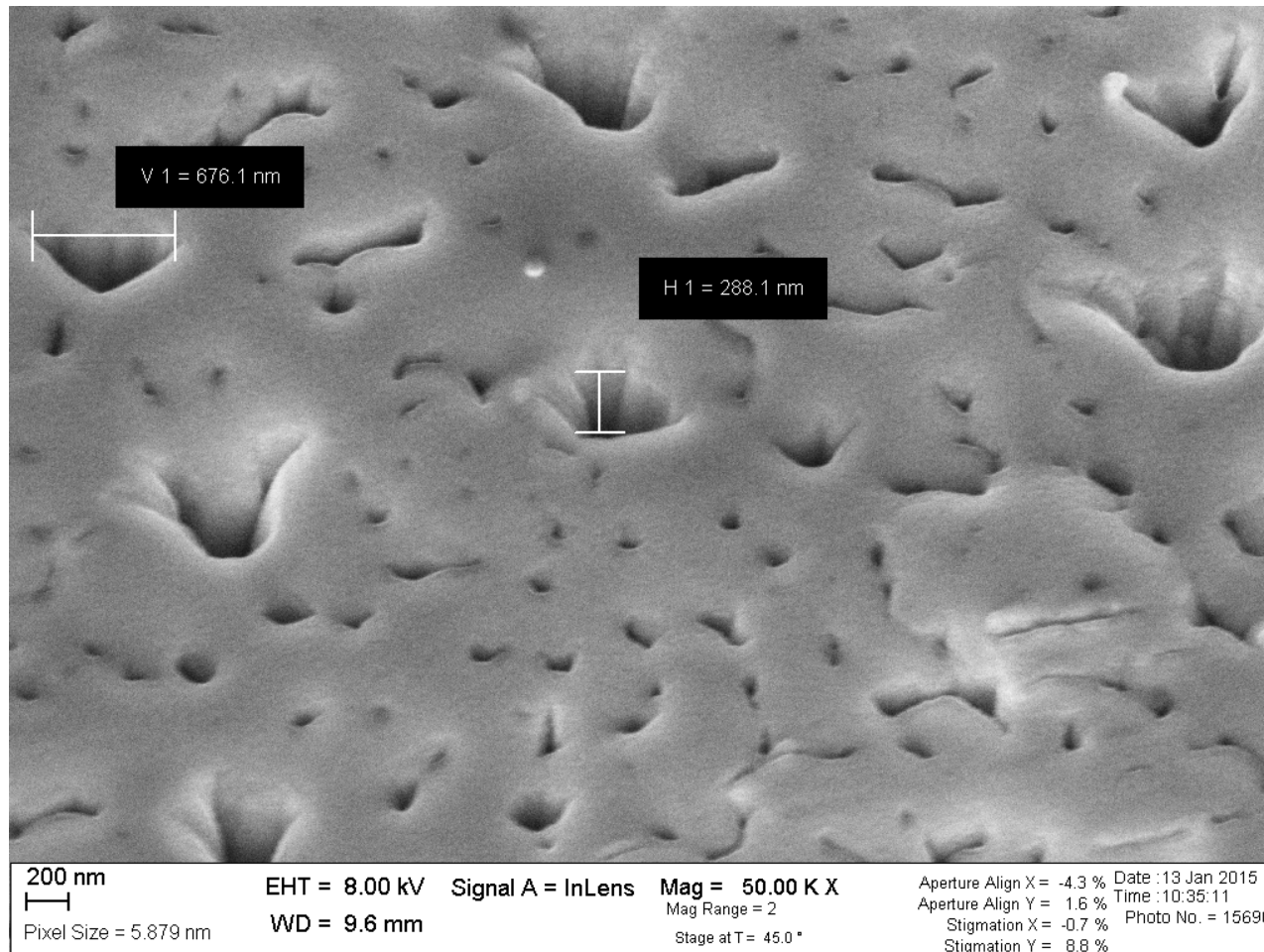
Ou, H., Advances in wide bandgap SiC for optoelectronics, The European Physical Journal B

Replication of nanostructures on polymer

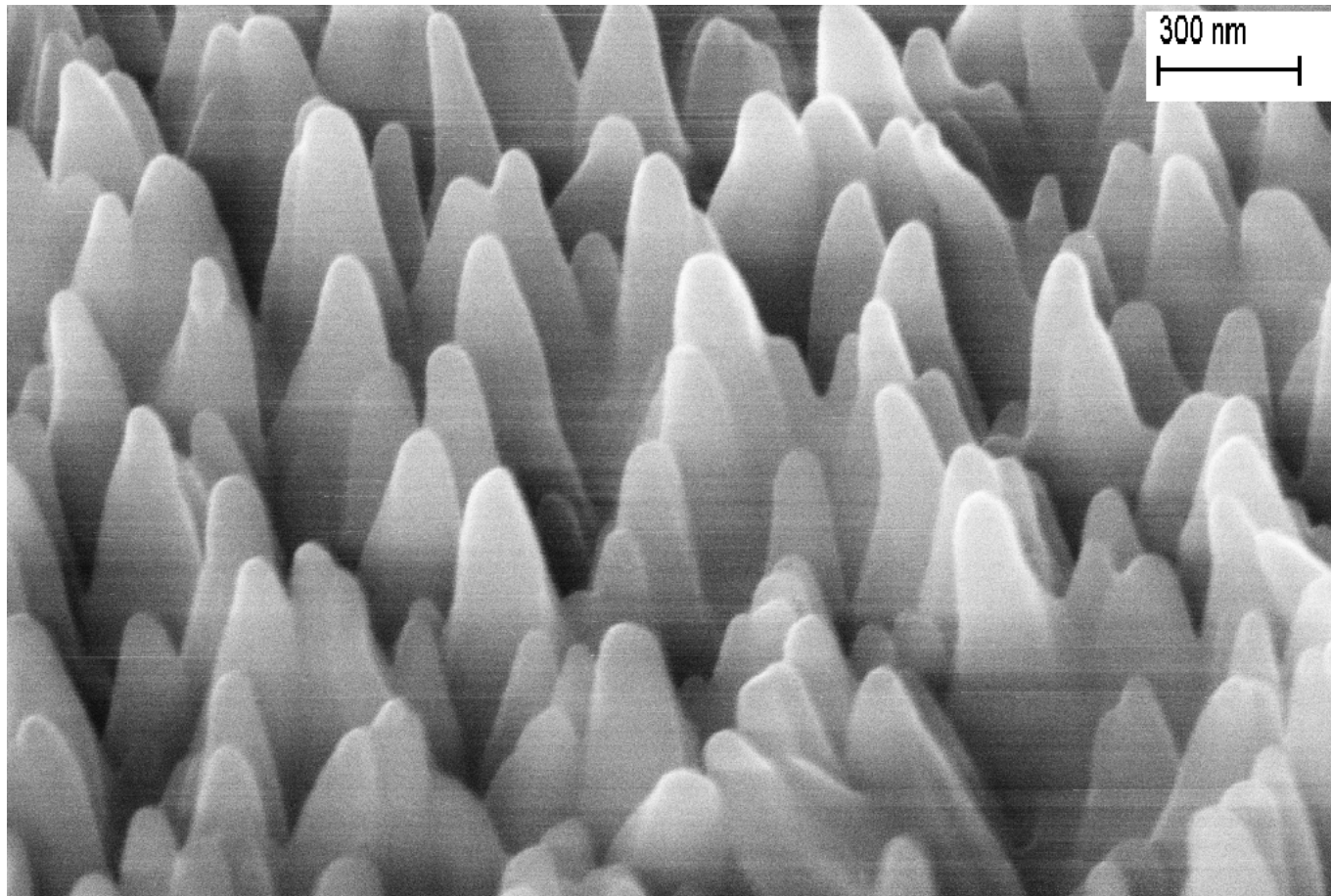


Process flow

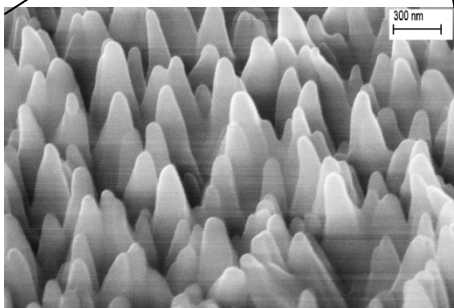
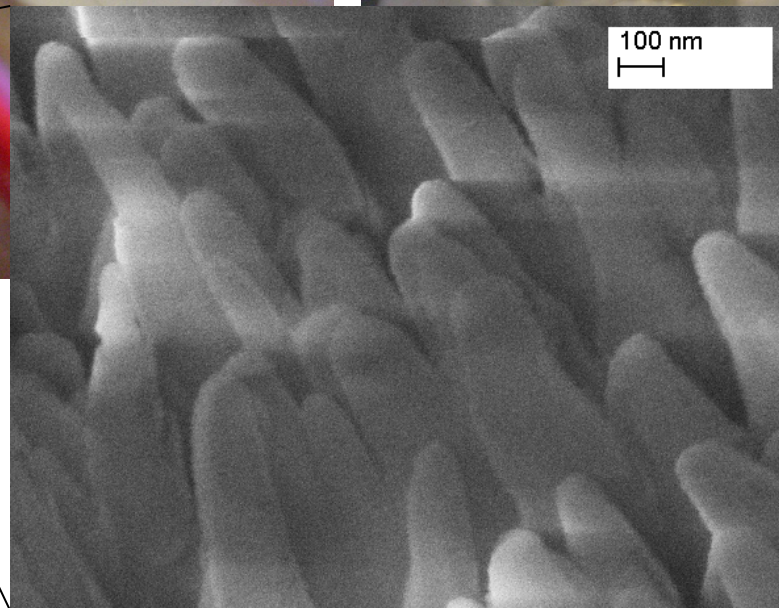
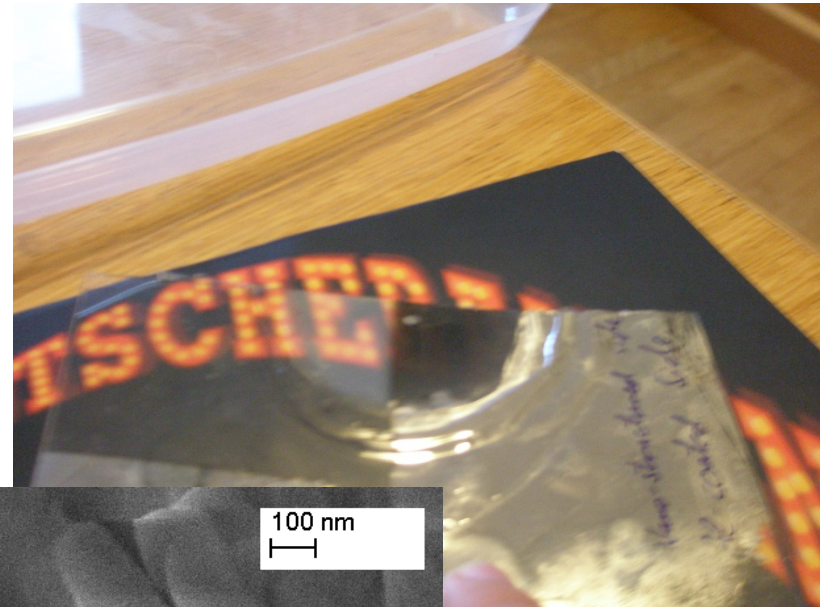
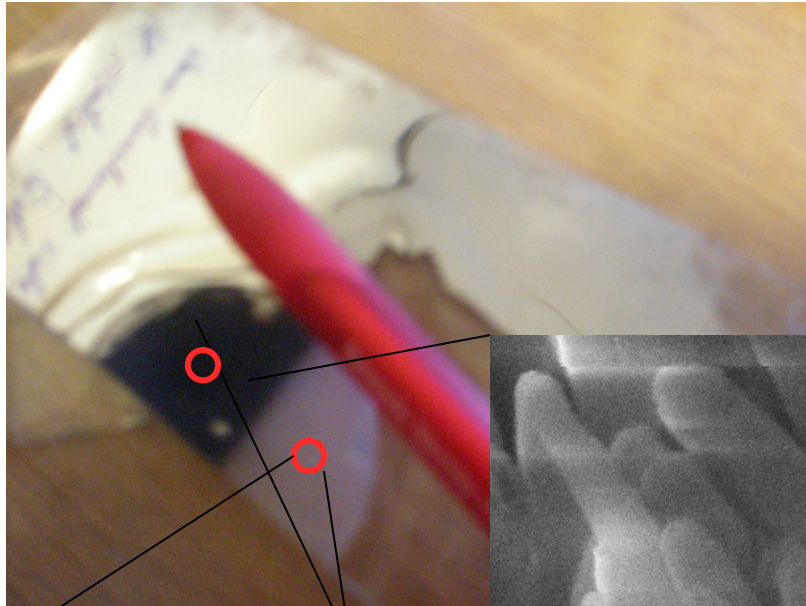
Ni shim: generation



Nanostructured polymer surface

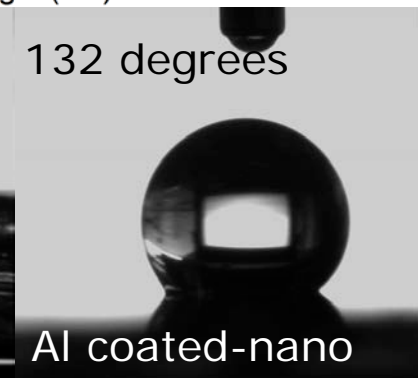
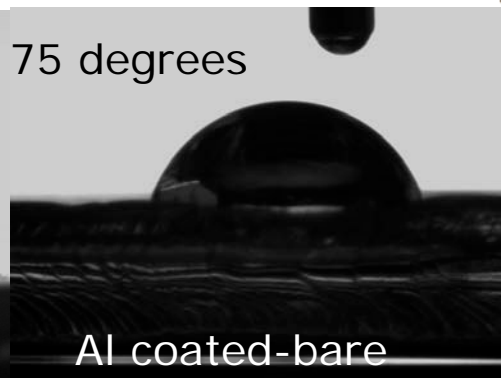
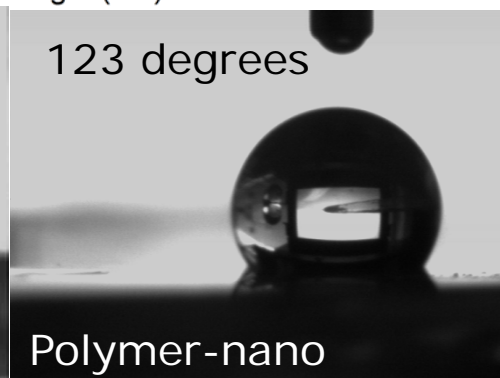
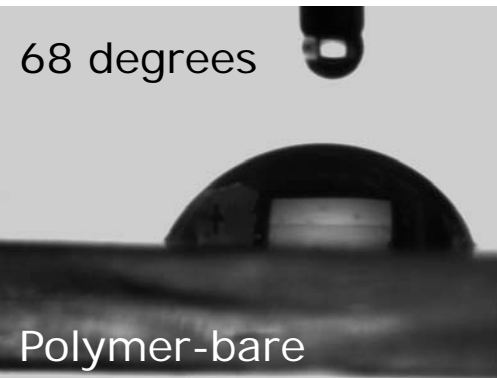
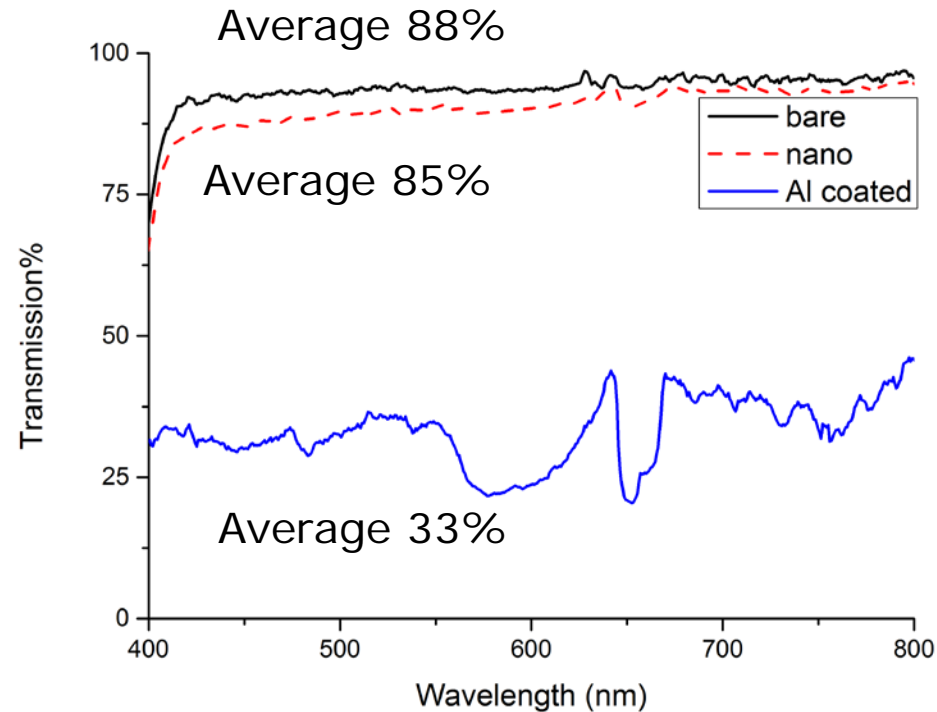
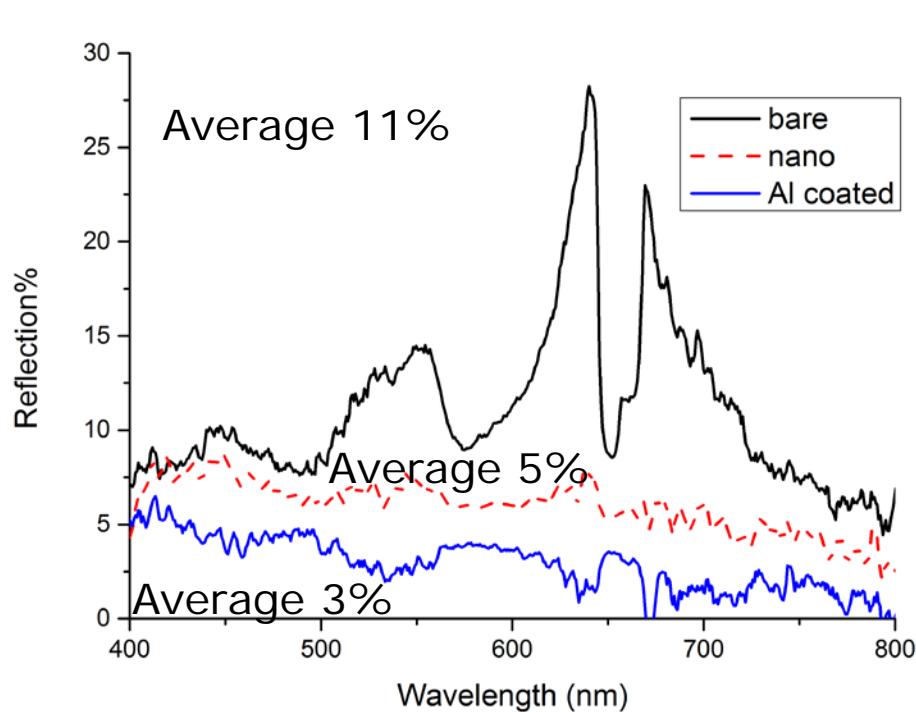


Color textures after nanostructuring on polymer



A thin Al
layer
(~40nm)

Optical and wetting properties after nanostructuring on polymer



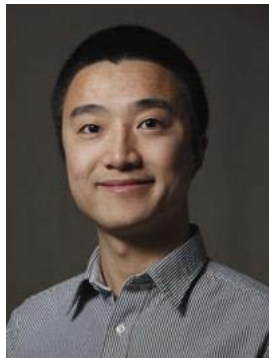
Conclusions

- Demonstrated 2 inch wafer nanostructuring on polymer by a SiC stamp
- Color texture and transmittance of SiC surface was controlled by nanotopography applied
- Color texture and reflectance of polymer surface was significantly altered by nanostructuring and additional deposition of a thin Al layer
- Wetting properties of surfaces shifted after nanostructuring from hydrophilic to hydrophobic

Acknowledgment



Weifang Lu



Yiyu Ou



Paul Michael Petersen



Haiyan Ou

Thank you for your attention

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